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ABSTRACT

Review of the methods for estimating future employment opportunities shows that there is an ongoing system, involving the Department of Labor and state employment agencies, for making projections for the United States as a whole and for states and major metropolitan areas. This system combines national research on economic growth, technological developments, and the structure of the economy with local information on industry trends and the labor market situation. Weak spots in the methods occur in making projections of the occupational composition of industries, and in accounting for mobility among occupations and patterns of withdrawal from, and return to, the labor force in individual occupations. Current research on economic growth, technological developments, and the occupational composition of industries may lead to improvements in the reliability of projections. Past projections have been moderately successful in identifying the expanding and declining industries and occupations, and in estimating rates of growth in expanding fields. However, in projecting the other major component of job openings, replacement of those who leave each occupation, the estimates have not been as accurate. Only estimates of deaths and net labor force withdrawals, calculated from averages, are available, and movement among occupations is not accounted for. Comparison of the job openings estimates with data on the numbers of people being trained for each occupation is essential in arriving at judgments about employment opportunities, and in adapting enrollments to prospective demand. However, problems with gathering statistics from the uncentralized vocational education establishment must be worked out for the two systems to work together to match employment demand and trained worker supply. (KC)

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FUTURE LABOR MARKET DEMAND AND VOCATIONAL EDUCATION

Paper prepared for the

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by

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Summary

The frequently-expressed desire of the Congress that vocational education provide training that is realistic in the light of anticipated opportunities for gainful employment has not always been effectively implemented in the planning of the programs. This paper examines the information on employment opportunities that is available for use in planning vocational education, as well as the information on training activity, and the problems of matching the two.

Review of the methods for estimating future employment opportunities shows that there is an ongoing system, involving the Department of Labor and State employment security agencies, for making projections for the United States as a whole and for States and major metropolitan areas. This system combines national research on economic growth, technological developments and the structure of the economy with local information on industry trends and the labor market situation. The projections are reviewed and revised frequently.

There are some weak spots in the methods, notably in making projections of the occupational composition of industries, and in accounting for mobility among occupations and patterns of withdrawal from, and return to, the labor force in individual occupations. At the same time, considerable research on economic growth, technological developments, and the occupational composition of industries is under way, and this should lead to improvements in the reliability of projections.

Reviews of the accuracy of projections made in the past show that they have been moderately successful in identifying the expanding and declining industries and occupations, and, among expanding fields, in estimating the rates of growth. These projected growth rates are an important component of the annual job openings which determine the employment opportunities for trainees. The other major component of job openings, replacement of those who leave each occupation, is not estimated as well. Only estimates of deaths and net labor force withdrawals are available, and the latter reflect average retirement patterns by age and sex, but not the specific experience of individual occupations. Movement among occupations is not accounted for. Research on this subject is going on, and one may hope that it will lead to improvement of the estimates.

Comparison of the job openings estimates with data on the numbers of people being trained for each occupation is essential in arriving at a judgment about employment opportunities, and in adapting enrollments to the prospective demand. Some problems in the training statistics, both for public vocational education and for other modes of training that make up nearly one-third of the total training effort for which we have data, will have to be eliminated before a complete match of training activity with job openings can be made. In addition, matching statistics from the two data systems—manpower and education--presents special difficulties that require being worked on.

Some of the difficulties in assuring adaptation of vocational education programs to employment opportunities arise out of the decentralization of control from Federal to State, and from State to local levels, and some arise out of rigidities inherent in an ongoing program involving specialized teachers and equipment.

FUTURE LABOR MARKET DEMAND AND VOCATIONAL EDUCATION

I. PREFACE: THE LEGISLATIVE BACKGROUND

The Congress has always seen vocational education pragmatically: its purpose is to prepare youths for the kinds of work they will be able to find in the labor market. This was made clear in the hearings on the Smith-Hughes Act of 1917 that initiated Federal support for vocational education, and was reiterated a half century later in the 1968 amendments to the Vocational Education Act of 1963 (P.L. 90-576), which set forth the purpose of the grants to States as to assist them in providing vocational training "which is realistic in the light of actual or anticipated opportunities for gainful employment" (Sec. 101). To make this concept operational, the Congress specified that information on employment opportunities needed would be developed by the Secretary of Labor, and the Commissioner of Education was authorized to transfer up to five million dollars a year to him to support "national, regional, state and local studies and projections of manpower needs for the use and guidance of Federal, State, and local officials" (Sec. 103).

Failure to achieve this purpose has been repeatedly observed over the years. In 1968 the Advisory Council on Vocational Education reported that little effort was made to adjust the programs to manpower needs, and four years later the Council reported that little progress had been made in this area. The General Accounting

Office said in 1974 that more manpower information was available by that time, but that it was hardly used in planning vocational education. (These reports are cited in Drews and Katz, 1975.) A 1975 study by the North Carolina State University Center for Occupational Information, funded by the National Institute for Education, attempted to account for the failure to use manpower information (Drews and Katz, 1975). It pointed to distrust of, disinterest in, and lack of understanding of manpower data and projections on the part of education officials, preference for depending on local advisory committees for information on employment opportunities, inertia ("Once a vocational education program is installed, manpower projections play a minor role in future programmatic decisions."), and failures of coordination and cooperation between educational and manpower agencies. Among the recommendations of the report was that a coordinating committee be established, representing national education and manpower agencies, and that a manpower information coordinator be employed in each state vocational education agency. The idea of a coordinating committee was supported by the Congress, and in the educational amendments of 1976 (P.L. 94-482) a National Occupational Information Coordinating Committee and cooperating State committees were authorized, to improve coordination between producers and users of occupational information, and to develop an occupational information system, including data on occupational supply, based on uniform definitions, classifications, and estimating procedures. The purpose, as stated by the House Committee on Education and Labor, was "to develop both occupational supply and demand data and to make this data readily available so that

vocational courses which are more relevant to realistic job opportunities can be offered." (NOICC, 1979, p. 2). This is the charge; how can it be done?

This paper will first discuss the methods by which occupational supply and demand data for the future can be developed. It will then describe and critically appraise the most comprehensive set of projections currently made for use in planning vocational education, those of the Bureau of Labor Statistics and related projections made by State employment security agencies. A final section will discuss the use of these projections together with information on current training activity, for planning vocational education.

II. PROJECTION OF LABOR DEMAND AND SUPPLY BY OCCUPATION: METHODOLOGICAL ASPECTS

A. Interpreting the Goal of Realistic Vocational Education

Traditional economic analysis tells us the vocational education system has no problem that the market cannot handle. Students will choose their courses of study to maximize their economic return, using as criteria the employment opportunities and wage rates offered by the various occupations. If, as a result of misjudgments on the part of students or economic changes, there should be more graduates than job openings, entrance wages will go down. At lower wages, employers will find it profitable to hire more in the occupation, until there are no more left looking for work--i.e., the market will be cleared. If there should be a shortage of graduates for the job openings, on the other hand, wages will rise, and only the firms which find it profitable to pay the higher wages will get the workers; the others

will make do without, and will either use other workers without the training or will substitute capital for the expensive labor. The market will efficiently allocate the supply; no one will be unemployed, and the employers who need the trained workers most will get them. Future groups of students will respond in their course choices to these events by switching out of low-wage occupations and into those paying better.

A refined version of this analysis, "human capital theory," has in recent years examined more closely how students make the decisions about choice of a course of training. This theory argues that an individual invests in education (not only the cost of schooling but also the income foregone in order to go to school) in the expectation of a return to this investment in the form of wages higher than he or she would have been able to earn before receiving the education. Since the higher wages will come in over the worker's lifetime, while the expenditure is in the present, the calculation of return has to allow for the interest the money would have earned if it had been invested elsewhere instead of being used for education. The question the student has to consider, therefore, is whether the education-induced increment in income over a working lifetime would exceed the cost of the education, plus interest. This calculation could set a minimum relative wage level for every occupation requiring training; if wages were below this level, workers would not be attracted to the training program. The theory further argues that occupations earning wages significantly higher would attract more workers, and so, if there were open access to education, the market would tend to equate the wages at a level not much above the return on investment in education (Becker, 1964; Blaug,

1976). A major problem in human capital calculations is determining the interest rate to be used in discounting future income streams to their current value. This makes an enormous difference in the return on investment over a working lifetime, and it is no small issue in the Spring of 1980 when interest rates have fluctuated by more than 50 percent in the space of a few months.

Human capital theory is a striking example of the ability of economists to develop a method of exquisite sophistication for calculating how an individual could maximize income, and use it in a theory that purports to describe behavior, totally disregarding the question whether people actually make this calculation. A high school or college student would have to have information on occupational wage differentials, the years of working life remaining to him or her at each age, and appropriate interest rates, as well as the mathematical ability to make the complex calculation. Yet the theory is that somehow people behave as if the calculation were made. It is difficult to understand the feedback mechanism from the market to individual decision-making that is assumed to exist. When pressed, proponents often fall back on the nation that a native folk-wisdom enables people to figure it out, proving that underneath many an economist's cold-eyed exterior beats a romantic heart.

Whether people choose occupations and enter training on the basis of a general belief that an occupation offers good employment and earnings opportunities, or whether they calculate it in the more sophisticated fashion suggested by human capital theory, the role assigned to the educational institution by traditional economic analysis is the same: schools need only maintain flexibility in training

programs in the various fields so that shifts in student interest can be accommodated, and enrollments expanded or contracted in response to the market.

If, indeed, the market were cleared by elastic wages and no graduates remained unemployed, the requirement to provide vocational education that is realistic in the light of employment opportunities might be easier to meet. But there are two factors that work against the efficient clearing of the markets for trained workers.

One of these is the length of the training period, which creates a lag between observation of the market situation by students and the adjustment of the supply of trained workers. The greatest opportunity for adjustment is at the point when people enter training. A well-publicized surplus or shortage in a field affects primarily the numbers entering the training programs, and only to a lesser extent people already in programs whose ability to shift fields is limited by the amount of time, effort and money they have already invested in courses. If the training program takes four or more years, as is true of college-trained occupations or apprentices in the crafts, the full effects of a labor market imbalance are not felt until four years later. In many cases there is over-reaction, so surpluses are succeeded four years later by shortages, and vice versa; moreover, the stage is set for a repetition of the pendulum-swing four years after that. This self-generating see-saw adjustment process is documented for a number of professional occupations, though it does not occur in all fields (Freeman, 1976). The effect of these swings is to accentuate the irregularities in flow of graduates into the labor market and to produce more severe surpluses or shortages than would otherwise be the case.

The second factor impeding the efficient clearing of the market is institutional rigidity. Employers do not appear to respond to supply/demand imbalances by raising or lowering wages as readily as classical economic analysis expects. The effect of changing supply on wage rates and therefore on demand needs more study than it has received, but a plausible hypothesis is that in most industries rigidities of the technology and the capital structure impede adjustment of the occupational mix or substitution between capital and labor, especially in response to wage changes that are perceived as temporary. Changing the occupational mix requires changing the production process or the equipment used. Raising wages of new entrants brings pressure to raise wages of the firm's other workers. These factors make demand relatively inelastic to the supply-induced wage changes. Industry will not hire more because they are cheaper, up to the point that the market is cleared. Instead, when there is a surplus of graduates some will remain unemployed until they are ultimately absorbed in other occupations; when there is a shortage, partly-qualified workers may be recruited from related occupations, in which case productivity will suffer. In short, social and economic costs are associated with the imbalances of demand and supply of newly-trained workers.

Under these circumstances, vocational education authorities cannot simply passively react to student demands for more or fewer enrollment opportunities and at the same time discharge their obligation to provide vocational education which is realistic in the light of actual or expected employment opportunities.

A first step in discharging this obligation is to provide information on future employment opportunities in the course of vocational guidance and counseling

services. Such information must look ahead at least as many years as the length of the training programs. It must also be specific as to employment opportunities in the geographic area in which the students are likely to seek work. Vague statements about "good" or "competitive" employment opportunities would be more helpful to individuals if supported by the estimates of numbers of job openings that are now provided to authorities responsible for planning training.

Giving the students reliable information on future employment opportunities in the various occupations should contribute to the adjustment of the supply of trained workers to the demand, and therefore help vocational education officials to provide vocational education that is realistic in the light of employment opportunities. But it would be over-optimistic to expect that information and counseling alone would accomplish a reasonable matching of supply to demand. When information on labor market outlooks is given to thousands of individuals, there is no assurance that the decisions they make will result in an optimum allocation of numbers of students among the various occupations. Describing an occupation as being difficult to get into may not--and probably should not--deter students who are interested and motivated from trying to be among the lucky few. This means that vocational education cannot discharge its responsibility without taking a look at the enrollments and the production of trained graduates in the light of employment opportunities, and, when necessary, taking steps to shift resources of teachers, classrooms and equipment from programs where fewer enrollments seem called for to those where more are justified. This is envisioned as one of the purposes of the state plans under the 1976 vocational education legislation (PL 94-482, October 12,

1976). The plans are required to assess current and future needs for job skills through data on present and projected employment, and to use this assessment to determine program goals, which are then to be spelled out in terms of the courses to be offered and the projected enrollments in those courses (Sec. 107).

In reviewing programs in the light of information on employment opportunities, the issue is, in most cases, not one of eliminating programs in certain occupational fields that are reported to have "surpluses" of workers, or of restricting vocational education to fields with "shortages." There are some job openings every year in almost all occupations, even those that are experiencing declines in employment; unless the decline is very rapid some new workers will be needed every year to fill openings resulting from deaths, retirements, withdrawals from the labor force, net out-mobility to other occupations, or net out-migration from the area. Favorable or unfavorable employment opportunities are a matter of the balance between job openings and applicants or newly graduated trainees; the key is in trying to adapt the flow of trainees to the openings expected at the time they will complete their training. This requires seeing that enrollments are in some reasonable balance with expected job openings several years hence (allowing for drop-outs, and switching of individuals among courses). Since some decisions, such as construction of facilities, recruitment and training of teachers, purchase of equipment, etc., require longer lead times, and since to make such investments the officials need some assurance that the openings for which they are training represent a continuing need, projection of job openings at least five years and preferably further into the future is necessary.

All this is not to say that to provide vocational education that is realistic in the light of employment opportunities schools should rigidly plan educational programs to move in lockstep with forecasted manpower demand. Fortunately there are too many obstacles to such planning in a free society of all-too-human people, including the desire of students to make their own career choices for their own lives, the many limits on the schools' ability to adapt flexibly, and recognition on the part of all concerned that forecasts have a margin of error. What is realistic to hope for, rather, is a reasonable accommodation of the enrollments and output of graduates to the job openings.

B. Methodologies: Description and Critical Appraisal

1. Early Attempts to Develop a Method to Relate Training To Employment Opportunities

Planning vocational education in the light of anticipated employment opportunities has been done in a variety of ways, and the methods that have been tried over the past range from those involving the most general and tenuous relationships between manpower needs and enrollments to the most precise, replete with numbers and verging on an accounting approach.

Some State and local vocational education officials have taken employment opportunities into account by seeking the advice of their industry advisory committees. Without derogating the real value of these advisory committees, it can safely be asserted, on the basis of experience in interviewing industry officials, that the views on future employment opportunities most industry representatives are likely

to have are highly impressionistic, and based primarily on past experience and the current situation, with little or no analysis of future changes. The contribution that industry can make to this question is not in the conclusions, but in the insights they can offer to help in analysis. They also should have a major role in advising on the content of training needed for entry into various occupations, and the adequacy of the training received by graduates whom they have employed.

An approach that has had a vogue among employment service officials selecting courses or occupations for training under CETA and other manpower programs is to identify "demand occupations" by flagging those for which local employment service offices get orders that they have trouble in filling locally, occupations in which there are lots of openings--in some cases because of high turnover--or occupations in which employment is projected to increase rapidly. This concept, muddy to start with, is a poor choice as basis for planning education, since it bears no quantitative relation to the annual needs for workers. A large occupation that is growing only moderately or not at all will still offer more job openings (because of attrition) than a small, fast-growing one. This is illustrated in Appendix Table 1. Seeking for "demand occupations" tends to concentrate attention on a narrow range of fast-growing or "shortage" occupations rather than the broad spectrum of occupations for which training is needed for growth and replacement of attrition.

In listing methods of relating enrollments to employment opportunities, we should not omit the use of the concept of "agribusiness" in developing statistics to justify enrollments in vocational agriculture. The proportion of American workers

engaged in agriculture has declined from 27 percent in 1920, in the early days of Federal support for vocational education, to 3.5 percent in 1980. To counter this adverse statistic, proponents of vocational agriculture developed the concept of "agribusiness," based on the fact that millions of workers are employed in business activities related to agriculture, such as processing, transportation and selling of farm products, manufacturing chemicals or machinery used in farming, making loans to farmers, etc. At one time total employment in all such industries was cited to show how many jobs were "related" to agriculture. More recently, an interagency committee on agribusiness employment opportunities has been paring down the list on the basis of the training actually needed. (Such a pared-down list is given in National Occupational Information Coordinating Committee, "Procedures for Estimating Employment Opportunities in Agribusiness," NOICC Administrative Memorandum No. 80-5, March 7, 1980.) Still identified as agribusiness occupations, however, are a few for which some knowledge about agriculture is necessary but for which the standard and accepted training is given either in other vocational education programs (such as trades and industrial, technical, distribution, health or office occupations) or in college-level programs in sciences, economics, business or veterinary medicine. The critical issue, of course, is not whether the occupation is related to agriculture, or health or any other concept, but what is the best way of training people for it.

A more serious attempt to develop information on training needs was the practice, followed for many years by employment security agencies, of making "skill surveys" in which employers were asked their present employment by occupation,

and also future employment anywhere from two to five years ahead. Such surveys have been made repeatedly over the years in the United States and in other countries, but have had an indifferent record of success in making accurate projections (Macro Systems, Inc., 1974; Moser, 1971). It has been found that few companies approached in these surveys have made careful estimates of their future manpower needs, or even projected the future volume of their business, and so answer the questionnaire, if at all, off the tops of their heads. Many project no change in employment, and it is not clear whether this represents a well-considered judgment or merely an unwillingness to make a projection or lack of understanding that a projection is requested. When the projections are compared with actual employment in the same firms for the target year, substantial errors are found for many occupations. The method does not provide for the employment in new plants not in the survey. Finally, the surveys are costly and involve duplicating collection of some of the same data already being collected in the Occupational Employment Statistics (OES) program in nearly all states, described below. In 1975 the Employment and Training Administration of the Department of Labor announced to the State agencies that it was abandoning skill surveys in favor of an analytical approach (Reports and Analysis Letter No. 11-75, July 3, 1975, reproduced in BLS, April 1979, pp. 53-56).

2. Analytical Methods: Demand

In analytical methods demand is estimated for each occupation on the basis of the factors that affect its employment and utilization. For example, demand for

teachers is estimated by projecting the population of school age, the proportion of population enrolled at the various grades, and ratios of teachers to pupils. Each of these is affected by a variety of social and economic factors which have to be examined; a simple extension of past trends may be deceiving.

Not all occupations have so direct a relationship between their market and employment. For those employed in many economic sectors, such as engineers, stenographers, or machinists, analysis has to be made of the markets for each industry as well as the changing role of each occupation in the industry.

a. Review of methods

Methods for analytical projections vary in complexity and sophistication, and the more complex, though more attractive to economists, are not necessarily the most accurate, especially when cost-effectiveness is considered. At one extreme is the simple extension of past trends in occupational employment--a method one may call analytical only in contrast to the skill survey method of relying wholly on the opinions expressed by employers. The rational basis for extrapolating past trends is the assumption that whatever factors have affected the level of employment in the past will continue to operate, and any changes that have been taking place in the relative strength of these factors will continue at about the same rate.

Somewhat more sophisticated are methods that decompose the past changes into their components, and project trends in these components separately, as in the illustration of teachers cited above. By examining the factors separately, the

analyst gains insight into the processes involved and the ability to make reasonable judgments on how they will operate.

Trends can be projected as continuing in a straight line the average growth rate of the past, determined mathematically by the method of least squares, or by more informal free-hand drawing of trend lines on charts. But few things in nature or in society move in a straight line, since they are affected by a variety of forces whose strength changes from time to time, and those engaged in making projections tend to try to find ways of projecting more reasonable curves. Some trends are assumed to be asymptotic a priori, such as the proportion of the population enrolled in school, which becomes harder to increase as it approaches some limit--100 percent in the case of elementary schools and some lower limit for higher levels of schooling. (But the selection of a point at which growth rates will taper off on the basis of some preconception of where upper limits are is risky; the history of projections of women's rates of participation in the labor force is a succession of instances in which reality broke through timidly tapered-off growth rates.)

At a higher level of sophistication have been economic models that attempt to identify causative factors influencing the employment or demand trend for an industry or occupation and then measure the relative effect of each factor by multiple regression analysis. If an equation that explains a high proportion of the past variation in the dependent variable (employment) can be developed, this is used to project future employment, if the independent variables can be projected independently. Thus, employment of engineers may be believed to be a

function of Gross National Product, capital investment by business, expenditures on research and development, and construction expenditures; if the relationship is tested empirically with data for past years and found to be a reliable predictor, and if estimates of the values of the causative variables for future years are available, the equation expressing the relationship can be used to project the employment of engineers.

This method has been elaborated further to develop economic models for all the major components of the national economy, consisting of a series of equations in which each variable is estimated for the future from its relationship with others, and each is then used in an equation to estimate another. (Thus in the illustration in the previous paragraph, residential construction--a major component of construction--could itself be projected by an equation relating it to such variables as population, family formation, and mortgage interest rates.) Some of the variables used in these models come from outside the system rather than being projected within the system by their relationship with other variables: future population, for example, is usually projected independently. Most of the economic models that have been developed for the United States are not used to develop projections of long-term trends but rather start with the most recent data and project changes quarter by quarter for a year or so into the future, using lagged or time-phased relationships in which variables are affected by other

variables one or more quarters earlier. Among the best-known of these models are the Wharton School, Data Resources, Inc., and Bureau of Economic Analysis (Department of Commerce) models.

This paper will discuss in some detail the Bureau of Labor Statistics economic growth projection methods, which are used not only in preparing the Occupational Outlook Handbook, but also to project employment demand by industry and occupation ten years or more into the future. They are the only methods currently in widespread use for making projections for planning education and training, both nationally and for States and local areas. They are generated in a continuing research program that issues revised projections every few years, reviews the accuracy of previous projections, conducts research on methods to improve projections, and collects necessary data on employment trends by industry and occupation for the nation, States and areas, on technology, productivity, and the labor market behavior associated with the demographic and social characteristics of individuals.

b. Assumptions

All analytical methods of projection have to begin with some assumptions about the future. A general assumption basic to all of them is that economic patterns persevere, and change only slowly. Since projections for educational planning are needed only for 5 to 10 years into the future, this assumption is generally a safe one.

Occasionally a major discontinuity in patterns occurs, however; the beginning of oil price control by OPEC in 1973, the most recent example, has profoundly affected the shape of the economy, not only by pulling the rug out from under the formerly dynamic automobile industry, but also by altering the terms of the trade-off between human labor and mechanization through raising the cost of energy--a change which may permanently slow the increase in productivity.

Other assumptions needed in making long-term projections have to do with the business cycle. Cycles are difficult to anticipate, since their timing and extent depend on government actions and international developments that cannot be guessed in advance. For this reason, long-term projections have usually attempted to discern only the underlying trends, and have disavowed trying to forecast the cycle; a smooth trend is projected even though it is expected that the actual course of events will be irregular. The assumptions as to the level of business activity and unemployment that are made in order to produce a smooth-trend projection have traditionally been assumptions of full employment, i.e., low levels of unemployment. The effect of this is that much of the time employment is actually below what has been projected, and therefore if training is closely geared to manpower demand under conditions of full employment some graduates will be unemployed in most years. This, of course, does not meet the requirement of planning vocational education in the light of anticipated employment opportunities. A more appropriate assumption, given the unpredictability of business cycles, would be some average level of unemployment rather than full employment, or at least a set of alternative projections based on such an assumption so that users of

the projections could see the effect on demand of a probable departure from full employment.

The full-employment assumption arises in part from the fact that government is not always in a position to make realistic assumptions. For example, one Secretary of Labor insisted that the government should not assume anything less than full employment in its official projections, and he defined full employment as a situation with no more than 3 percent unemployment, which at that time was considered to be the irreducible minimum (allowing for some people to be without jobs and looking for work at any time--so-called "frictional unemployment"). This level of unemployment was never attained in peacetime.

The difference between such unrealistically low assumptions and some average level of unemployment is no more than 2 or 3 percentage points, which, when expressed in terms of the level of employment becomes minimal--well within the error range on long-term projections. For some occupations sensitive to the business cycle, however, such as building trades, the difference in employment could be several times the 2 or 3 percent average for all occupations.

Another assumption that may give trouble in projections to be used for educational planning is that some socially desirable goal in level of services or goods production will be met. From time to time authoritative groups set goals in such fields as health, education, housing, pollution control, etc., and estimates of manpower requirements to attain these goals are made. This is a useful exercise if the goals are to be taken seriously and implemented by legislation; educational policies can be

adjusted to assure that the skilled workers will be available. But clearly such goals should be considered in planning education only if they are to be implemented; the concept of effective demand should govern the planning of vocational education.

The assumptions underlying the projections by the BLS to 1990 used in this report have been stated as follows:

> Inflation will decelerate to 5.2 percent annually during 1980-1990.
>
> A stable, long-run unemployment rate close to 4.5 percent will be achieved by the mid-1980's.
>
> Higher energy prices will not constrain growth in GNP.
>
> The institutional framework of the U.S. economy will not change radically.
>
> Current social, technological, and scientific trends will continue.
>
> No major event such as widespread or long-lasting energy shortages or war will significantly alter the industrial structure of the economy or alter the rate of economic growth. (Bureau of Labor Statistics, Occupational Projections and Training Data, 1980 edition)

A more complete statement of the assumptions lists the population projections of the Bureau of the Census, Federal personal income taxes, an inflation rate lower than the average since 1973 but above that for 1948-1968, a slow recovery in the rate of increase of productivity, and about 30 other explicit assumptions that include, for example, the Social Security contribution rate, Federal transfer payments, exports, and corporate profits tax rates. (Bureau of Labor Statistics, Methodology for Projections of Industry Employment to 1990, pages 6-7).

The advantage for users of this explicit statement of assumptions is that a judgment can be made as to their effects on the outcome. If, for example, one believes

that the increase in energy costs will impede the substitution of machinery for human labor and slow the rate of productivity growth, this can be allowed for. Specifying the assumptions helps the reader to know how many grains of salt to take the projections with.

c. BLS projection methods

The BLS methods for projecting demand will be described in four phases: national projections of employment demand by industry, national projections of employment demand by occupation, projections of supply, and State and local projections.

As noted in the section on concepts, above, the projections of demand are more precisely described as projections of demand assuming that the relative wages of the various occupations remain substantially unchanged.

The first phase, projections of industry employment levels, is accomplished by constructing an estimate of the functioning of the entire economy in 1985 and 1990, so that the demands generated by consumers, government and capital investment for the products of each industry can be estimated.

The following description is a brief summary of a more complete statement published in the Bureau's Methodology for Projections of Industry Employment to 1990.

The rationale of the projections is to estimate the structure and composition of the economy of the United States ten years hence if our human resources are fully employed. Starting with the growth of the population as estimated by the Bureau of the Census, the BLS projects the growth of the labor force, then estimates what the

GNP would be if this labor force were fully employed, allowing for rising productivity and continued decline in hours of work. (The unemployment assumption is 4.5 percent, a more realistic version of a full-employment assumption.) The demand for each kind of goods or services generated by the income associated with the GNP is estimated, and from this, industry production and employment levels are estimated.

There are four major steps in this phase:

(1) The broad character of the economy is projected by means of a 50-equation macro-economic model that starts with the population and labor force projections, the assumptions as to unemployment, productivity, hours of work and the thirty-odd other specific assumptions mentioned above, and spells out the GNP on both the supply side (labor and capital inputs and the income flows that would be generated) and the demand side (personal consumption, government purchases, investment, and net foreign trade). This elaborate portrait of the economy goes into considerable detail, including, among others, estimates of corporate dividend payments, state and local government employment, the stock of capital equipment, indirect Federal taxes, imports, wage levels, and median family income.

(2) The demand for each type of product or service that would be generated by the consumer income, government purchases, capital investment and exports is then estimated. This is done by examining the past relationships between the amounts of these categories of demand and the amounts of products or services bought, first in broad groupings, such as health care, consumers' durable goods, military equipment and industrial machinery, and then in more specific products or services produced by

the 162 industry sectors used in the projections. Exports and imports of specific products are estimated at this stage and brought into balance in the projected year (the balance being an assumption that represents a policy target). (Some other specific policy targets that enter into the projections at this stage include a very slow rise in crude petroleum imports and an assumption that American automobile manufacturers will retain their share of domestic markets--an apparent contradiction that can be resolved only if the world's leading automobile industry can learn to build a car that does not guzzle.)

(3) The effect of these purchases of final products upon the industries producing raw materials and components, and transportation and other services required in production are then estimated, using an input/output table. An input/output table shows the sales of each industry to every other industry in a given year, and therefore the purchases of each industry from every other one. These relationships reflect the technology of each industry as well as the relative prices of alternative inputs. Tables were projected for 1980, 1985 and 1990, using past trends in the relationships and allowing for expected changes, such as in the types of energy consumed. Although the input/output tables are estimated in constant relative prices to measure real changes in quantities of production, it is hoped by BLS that the effect of changing relative prices on what industries buy is reflected in the changing relationships projected. This step produces a set of production level estimates for each industry, consistent with the final demand for each product and service estimated in the second step.

(4) The production levels in each industry for the forecast years are translated

into manpower requirements on the basis of projections of output per man-hour (or productivity) and average hours of work. Productivity is projected either as a trend over time or as a variable depending on the level of output in the industry and the proportion of white-collar workers (a proxy for the quality of labor used) or some combination of these factors. In some cases judgment was used in making the projections rather than one of these mathematical methods. The work is backed up by intensive studies of technological change and productivity trends in many industries, which are used both in projecting the input/output relationships among industries and in projecting industry productivity.

An advantage of this method is that so much of the composition of the economy is treated explicitly. This makes it possible to change certain of the assumptions and estimate the effect of alternative economic policies or events, such as a major synthetic fuels program or greater defense spending.

How well does this elaborate method project employment changes? The ultimate test is to compare a projection with the actual employment situation when the forecast year rolls around. Some of the difference may be due to the assumptions used--e.g., the phase of the business cycle as represented by the assumption as to the unemployment rate. Others may be due to errors in the methodology or in the data used.

We get some insight into the accuracy of the BLS methods from an analysis of the industry employment projections for 1970 which had been published in 1966 on the basis of data through 1964--i.e., projections six years ahead (Personick and Sylvester,

1976).* Total employment increased by 17 percent instead of the 15 percent projected. The direction of employment change was correctly projected for 63 of the 74 industries. Out of 9 industries in which declines occurred, declines were predicted in 7; on the other hand, the projections predicted declines in 9 industries that actually had increases. The percentage changes projected for the individual industries from 1964 to 1970 were fairly close to the changes that actually occurred (correlation coefficient of .58). The largest source of error was in step 4, the projection of industry productivity changes; second largest was in step 3, the projection of input/output relationships among industries. The basic conditional assumptions, such as that for the unemployment rate, had a smaller effect on the error in the final results.

In an interesting commentary on the advantages of the elaborate method, the evaluation study compared the results with those that would have been achieved by a variety of simple methods for forecasting. It was found that industry employment would have been more accurately projected from 1964 to 1970 by a simple least squares growth rate fitted to past trends in employment in each industry! The lesson drawn by BLS was not to abandon the elaborate method, but to work on improving its weakest steps, notably the industry productivity projections. This decision is understandable: we would have little faith in an automobile mechanic who found he could

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* A later evaluation by BLS of industry employment projections for 1975, prepared in 1971, is not used in this paper because it does not show projected and actual percent changes on a comparable basis, and because this four-year projection was severely thrown off by the 1975 recession (only half the industries expected to grow actually grew). See Christy and Horowitz (1979).

start a stalled car by kicking the tire and then considered his work was done. The simple method might not work the next time the car stalled. The instinct of workmanship argues for taking the projection methodology apart and fixing what went wrong.

The second phase of the demand projections, translating industry employment levels into occupational employment, is accomplished by means of data on the occupational composition of each industry. The projected occupational composition for the forecast year is used to estimate employment by occupation in each industry, and the total for each occupation in all industries is then calculated. (Occupations whose demand can be directly estimated, such as teachers, automobile mechanics, nurses, and cosmetologists, are projected separately and then fitted into the structure.)

Data on the occupational composition of industries has up to recently been available only from the decennial censuses of population, in which members of each household report the occupation and the industry in which they work, and, for a very few industries (railroads, telephone) from reports to regulatory agencies. Trends in the composition of each industry are analyzed from these sources, and related to known changes in industry technology to estimate composition in the forecast year. Intensive studies of technological changes and their effects on occupational requirements have been made for 30 major industries (listed in the latest in this series, Bulletin 2033). For other industries trends in the occupational composition of industries shown in decennial censuses have been

projected. There is little science in these estimates; they are done mainly by exercise of judgment. In recent years collection of data on occupational employment from industry has begun, in the Occupational Employment Statistics (OES) program in which most States are now participating. The employers are asked to report employment in each occupation on a special list for each industry that includes not only the occupations employed in that industry but also brief definitions. This is likely to be more accurate than reports from households, and since it is capable of being analyzed by the factors that may affect occupational composition, such as size of firm and the particular production process used, it may make better projections of occupational composition possible. The OES has not yet been extended to all States, however, because its financing is inadequate and uncertain. The necessary research on the data collected has barely been begun; this is indicated by the fact that questions on the production process used--essential to understanding the reasons for differences in occupational composition among plants in the same industry--have not yet been asked in the survey.

The BLS has published an evaluation of its occupational employment projections (Carey, 1980), comparing actual 1975 employment data with projections it made for 1975 in 1967. They found that projections of the major occupation groups were more accurate than those for individual occupations, being protected by the patron saint of all forecasters, Offsetting Errors. Projections for large occupations had less error than those for small ones, partly because the actual

1975 data used to check the forecasts were based on a sample survey (the Current Population Survey) in which the relative errors for small estimates were larger than for large estimates. In 64 of 76 occupations for which a comparison was possible, the direction of change was projected correctly. Out of 11 occupations in which there were actual declines, the projections correctly predicted declines in only 5. The percent changes projected for the individual occupations for the period from 1960 to 1975 were fairly close to the changes that actually occurred (correlation coefficient of .78). The differences between projected and actual change were frequently large (more than 30 percentage points in one-third of the cases), but the range of actual percent changes was also large--from -75 percent to +259 percent.

One component of the errors was the assumption as to unemployment: the projection assumed a 3 percent rate, and actual unemployment in 1975 was 8.5 percent. When this difference is taken together with a labor force growth greater than projected and an Armed Forces lower than was assumed, the increase in civilian employment was 2.4 million (or 2.7 percent) lower than had been projected. This factor resulted in underestimates of growth for many of the blue-collar occupations, which are most affected by business downturns. This illustrates the anomaly of using actual employment in the forecast year to check the accuracy of a projection that attempts to discern only long-term trends, abstracted from the effects of the business cycle.

The greatest source of error was in the projections of occupational composition of industries. When the projected occupational composition for each industry was used to distribute actual 1975 employment in each industry, there was no improvement in the occupational projections; in other words, most of the error was in the projected occupational composition rather than in the industry employment projections. This confirms a similar conclusion in an earlier study of the accuracy of BLS occupational projections for scientific and technical occupations (Goldstein, 1974).

3. Analytical Methods: Supply

Supply of workers for an occupation consists of the persons who seek employment at current wages and conditions of work. When wages rise relative to those in other occupations available to the same people, more of them seek work in the occupation. This implies an elastic supply, and the existence of a potential supply larger than the actual one at any time. The potential supply includes workers qualified for employment in the occupation who are currently employed in other occupations, unemployed, not in the labor force (e.g., women engaged in home activities, retired persons, and students), and immigrants. The size of the potential supply is affected by the qualifications for employment: occupations requiring licensure, union membership, special training, etc. typically have more limited potential supply.

The elasticity of supply, even in some occupations requiring long periods of training, is illustrated in studies of inter-occupational mobility. For example, a recent study compared the status of individuals in a current month with that reported

one year earlier; data for six of such over-the-year comparisons in the period 1973-1976 were brought together (Eck, 1980). It was found that 7.7 percent of the workers currently employed had been employed in a different occupation one year earlier, and movement out of the occupations to others was of similar magnitude. Differences among occupations in the rate of in-mobility reflect the levels of training needed, and differences in out-mobility reflect, among other factors, career patterns--moving up to higher-paid occupations. In the following table, excerpted from the study, the "In" column shows the percent of workers currently employed who were in another occupation a year earlier, and the "Out" column the percentage of those employed in the occupation a year earlier who worked in another occupation in the current year:

	IN	OUT
Engineers	4.6	8.9
Physicians and dentists	1.9	0
Accountants	5.4	6.9
Lawyers	2.6	0
Carpenters	10.0	11.2
Electricians	3.6	2.8
Machinists	8.7	0
Plumbers	5.9	1.2
Cooks	7.0	8.2
Construction laborers	13.6	15.0
Garage workers and gas station attendants	17.4	20.2

For some of the occupations exits are few, and many of the entrants are new graduates who had some other job while in school, or before getting their first job in the field. Other occupations have a relatively large outflow. In the cases of engineers and accountants this partly reflects movement up to management jobs; in the cases of construction laborers and garage workers and gas station attendants some of the outflow

represents moving up to more skilled jobs, and some may represent just getting out of a low-paid job in which the worker has not invested time or money for training.

The relevance of this to vocational education is obvious; depending upon the qualifications for entry, a substantial proportion of the job openings in an occupation could be filled from among people already in the work force, in related occupations, and would not be available to the current year's graduates from vocational programs.

Occupational supply has to be analyzed in terms of flows into and out of the occupation. Inflows, as indicated above, include graduates of training programs, persons who did not complete training but acquired enough of the skills to qualify for employment, persons from other occupations, persons temporarily out of the labor market who are returning (some of whom had previously worked in the occupation or had been trained for it), and immigrants. Outflows include deaths, retirements, temporary withdrawals from the labor force, persons shifting to other occupations, and emigrants.

Because of the many doors through which people can enter or leave an occupation, a question arises as to how to count the employment opportunities for purposes of planning vocational education. In a sense, every time a worker leaves a job in the occupation a job opening arises, providing an opportunity for which a newly-trained worker could compete. In this sense, all job openings are available to newly-trained workers. This is not a valid approach for planning training programs, however. If training were stepped up to provide a number of graduates each year equal to the total number of job openings that occur in a year, the field would soon be flooded by a

massive surplus of workers. For planning training, the appropriate measure is the net number of job openings for which newly-trained workers are needed. This is the sum of the net growth in demand, plus replacements for net retirements (withdrawals from the labor force, less returns to the labor force*), plus deaths, plus net occupational mobility (transfers to other occupations, less transfers from other occupations), plus net migration (emigration of workers employed in the occupation, less immigration of qualified workers).

Not all of these elements can be estimated, unfortunately. Deaths and net labor force withdrawals (mostly retirements) are estimated by the BLS on the basis of tables of working life that reflect the impact on men and women at each age of death rates and changes in labor force participation rates for the entire population. Differentials among occupations in mortality and in patterns of retirement are not reflected in the tables; they show only the effects of differences among occupations in age and sex composition. Research has been conducted on other elements of mobility and on occupation-specific retirement patterns. Data for a large number of occupations were collected in the 1970 census of population, in which people were asked whether they were employed in 1965 and in what occupation. The status of individuals for 1965 and 1970 were matched

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*The data on changes in status in household surveys identify people who were not in the labor force in the earlier period and were employed in some occupation in the later period, but fail to distinguish between those who were in school and those who were not in the labor force for other reasons (housewives, ill or disabled). For data on replacements for net retirement, we need to exclude those in school in the earlier period.

(Sommers and Eck, 1977). The more recent data published by Eck in 1980 have already been referred to. There are substantial errors in both these bodies of data resulting from imprecision in reporting occupation, mistakes in classifying the titles reported into the proper categories in the census occupational classification system, and, in Eck's data, technical problems in matching households. When the two bodies of data, reflecting two quite different economic situations, are compared, there are considerable similarities in patterns for the same occupations with respect to mobility into the occupation from other occupations and with respect to exits from the labor force, but less similarity with respect to mobility to other occupations and entrances to the labor force. It is also difficult to distinguish between new entrants graduating from training programs and those who came from other occupations; a student working while in school is shown as a transfer from another occupation.

Because the mobility data are as yet inconclusive, BLS continues to use only death and retirement estimates based on tables of working life in its published estimates (Sommers and Cohen, 1980). The attrition estimates, therefore, understate the total number of job openings arising annually in any occupation that has positive net occupational mobility, or for which the typical retirement rates are higher than those for the labor force as a whole. For example, engineers lose 4.3 percent more than they gain from other occupations according to the table above; this is double the death and retirement rate for engineers as estimated from tables of working life.

Net migration is allowed for in a few occupations where data on immigration are available and have a significant impact. There are no data on emigration by occupation.

4. Analytical Methods: State and Local Projections

At one time State and local projections were done entirely by employer opinion surveys, but as nationwide projection methods were developed and repeatedly used, the possibility of using them as a framework and economic context for State projections arose. The impetus came from the Vocational Education Act of 1963 and the amendments in 1968, which created a need for State and local manpower projections. They were also needed for planning training under the Manpower Development and Training Act of 1962 and its successors, including the Comprehensive Employment and Training Act of 1973 (CETA). In 1969, BLS issued Tomorrow's Manpower Needs, a four-volume manual for using national data and projections in developing State projections, and State projections in developing local ones. Over the subsequent years these methods, with some improvements, were increasingly used by the States. The launching in 1971 of a cooperative Federal-State program of collecting statistics on employment by occupation from industry was supported by the State interest in this method of making projections.

The method emphasized the projection of State and local economies within

the framework of the national economy as projected by BLS, rather than an attempt to make de novo projections. It operated in several steps:

(1) The State was encouraged to make its own projections of employment by industry in the State within the context of the national projection for each industry. The national projection already takes into account the growth of population and purchasing power, technological developments, changing patterns of consumption, and trends in imports and exports. Use of regression equations relating the State's employment in the industry to national employment and to such local factors as population or labor force growth were suggested. The State was encouraged to use this as a starting-point, and to take into account other techniques, such as "shift-share" methods for analyzing geographic distribution of employment, and whatever information it could get within the State that might affect future trends. The State employment security agencies were also encouraged to cooperate with other agencies, universities, or research groups on projections; in North Carolina, for example, the employment security agency coordinates its projection work with that of the industrial development agency, and gets the benefit of that agency's knowledge of potential industry developments.

(2) The occupational composition of each industry is applied to the State's present employment by industry to yield estimates of current employment by occupation, and a projected composition pattern is applied to the projected

employment levels to yield estimates of employment by occupation in the forecast year.

At first the national occupational/industry matrix developed from the decennial census was used, but because of the likelihood that the occupational mix might differ from State to State within an industry (especially as some of the industries were defined broadly in the census tabulations) State occupational/industry matrices were developed from the population census. As the occupational employment statistics collection program got under way, States seized on this as giving more current data. The program involves surveys of all nonfarm industries over a three-year cycle. The OES survey also provides more accurate reporting on occupation than a household survey like the census, since it uses a special list of occupations for each industry, with accompanying definitions. Because the data are collected from employers, rather than summarized from household reports, the characteristics of the firm can be identified. The possibility is therefore opened for analysis of occupational composition by size of plant, product mix, technology used, and other factors that may affect it; this should make it possible to improve the projections of occupational composition. Unfortunately, the necessary data on technology or process used, and on product mix, has not yet been collected, and this unique opportunity offered by the survey has not been exploited.

(3) Occupational attrition was estimated from the age composition of each occupation in the State as of the most recent population census, using

the national tables of working life. As with the national projections, no account was taken of net occupational mobility or differential retirement patterns. An additional element of mobility applying to state and local estimates of job openings--net interstate migration--is also ignored.

(4) States that wished to develop projections for metropolitan areas or other subdivisions of the State could do so by repeating the same steps.

Nearly all the States have completed one or more repetitive cycles of projections and provided them to vocational education officials; most have also published them.

Upon the principle that the larger aggregates being estimated the more likelihood there is for errors to offset each other, it follows that as a group the State projections developed from national projections are likely to have more error than the national. The effect of a single plant closing or new plant opening can be appreciable in a State or local projection.

The methodology represents a way of making maximum use of both national projections of factors affecting the economy of every State--population and GNP growth, technological changes, foreign trade, taxation, transfer payments through Social Security and other programs, etc.--and State and local special knowledge of their own economies. It should result in a consistent set of projections adding to national totals, if the sum of the 50 States' own projections of their share of national employment in each industry equals 100 percent.

It would be natural, however, to expect some aggregate overstatement: States that have gained increasing shares of an industry's jobs are likely to be optimistic, while those that have been losing are likely to be conservative in projecting continued declines, and to expect a stabilization following whatever measures the State administration takes to retain industry. The BLS reviews the projections and gives technical advice and assistance, but does not check them for consistency with each other or with the national total. One reason for this is that the projections are made at different times and for different target years, making addition across the States impossible.

A recent study comparing this method of making State and local projections with several alternative methods, including econometric models and input/output analyses, concludes that the present method is in general the most effective because of its accuracy, low cost and its use of readily available data. Better projections could be made by econometric models in situations involving less-stable local economies, in areas in which there are strong linkages among local industries (i.e., where a high proportion of raw materials and other inputs are purchased locally), or in areas in which markets are mainly local rather than national (Harvey Goldstein, 1980).

5. Summary Comment on Projection Methods

From the above description of the BLS and associated State agency methods of making manpower projections several points emerge:

(1) While some steps in the projections are worked out in a scholarly fashion, meticulously and with sophisticated data and methods, others are done in a much cruder fashion. The final results are open to substantial errors, not only as shown by comparison of the projections with the actual employment levels in the target year, but also because of the understatement of net openings resulting from attrition. The unevenness in methodological sophistication reflects inevitable differences in the state of the art, but also to some extent reflects misapplication of effort--concentration on work which the experts know how to do and for which data are available, and inadequate allocation of resources to research to improve the weakest areas of the projection system. Among the latter are projections of the occupational composition of industries, the use of average age/sex specific retirement rates for the whole labor force in the absence of rates for specific occupations, and failure to allow for net inter-occupational and inter-state mobility.

(2) A second comment is that this method had been criticized from the vantage point of neo-classical economics because it assumes a continuation of relationships among economic variables regardless of possible changes in relative prices or wages. The mix of inputs to each industry could change if relative prices of competing raw materials changed. Similarly, the relative use of capital and labor could change, depending on their relative prices; or the mix of occupations in an industry could be

affected by changing relative wages. One response of BLS is that when input coefficients in the input/output table are adjusted for future years on the basis of past trends that show them changing, or when the occupational composition of an industry is similarly adjusted for a future year in line with past trends in composition, the effect of changing relative prices or wages in the past (as well as the effect of other factors, such as technological innovation) is implicitly taken into account. This answer does not meet the criticism wholly, for past changes may not presage future changes in prices. Not enough empirical research has been done on the actual response of occupational mix to changing relative wages; it may be that it differs among industries, depending on the rigidities imposed by the technology (which may represent a large capital investment) and on the effect of wage differentials on total labor costs. A high wage in a small occupation may not have enough effect on costs to impel management to change production methods.

III. PROJECTIONS OF MANPOWER DEMAND BY OCCUPATION, 1978-1990

A. Introduction

For this discussion we will use the national projections published by the Bureau of Labor Statistics. The BLS began publishing projections for planning education only recently, although it has made projections for more than thirty years for use in appraising the employment outlook in occupations for the information of youth interested in making career choices. The occupational outlook research work was initiated at the

recommendation of a Presidential Advisory Committee on Education in 1938, which referred to the use of the information both in vocational guidance and in planning education. The first report, on diesel-engine mechanics, was published in 1945; in 1949 employment outlooks in a large number of occupations were published in the first Occupational Outlook Handbook. A second edition was issued in 1951, and the publication has been biennial since 1957; currently about 150,000 copies of each edition are sold.

The BLS hesitated to issue projections of numbers that could be used in planning training programs, partly because of diffidence about the accuracy of such numbers, and partly because there was little demand for such information. As related research programs developed on economic growth (with which the occupational outlook research was combined in 1980) and on productivity and technological developments, and as it had an opportunity to check its earliest projections against the actual data in the forecast years, the BLS developed more confidence in its methods. When the vocational education and manpower legislation of the 1960's created a larger demand for quantitative projections, a decision was made to issue quantitative projections.

In 1971 the first publication specifically designed for this purpose was issued, Occupational Manpower and Training Needs. The fourth in the series, with the title changed to Occupational Projections and Training Data, will be issued in 1980. The unique contribution of this report is that it brings together data on manpower demand and manpower training for several hundred of the major occupations for which training is required, and tries to make some sense of it. It is the only systematic compendium

of data on the numbers of persons completing training for work in each occupation by all modes of training for which data exist in the United States--including public and private vocational education, apprenticeship, Armed Forces training in occupations similar to civilian occupations, the Job Corps, community and junior colleges, and four-year colleges and universities. The report notes that it misses the trainees completing Federally-supported employment and training programs (national summaries, once available, were discontinued by the Labor Department in an excess of zeal for decentralization), and training in industry and through home study courses, neither of which has been completely surveyed. The number of people who completed courses in 1976 in all the training programs other than four-year colleges and universities amounted to 3.4 million, of whom 70 percent were in public vocational education (Harold Goldstein, 1980). Thus about 30 percent of the trained workers are contributed by other programs, whose output has to be taken into account in comparing the numbers trained with the job openings. The report comes as close as possible to providing the information needed to compare current training activity with estimates of manpower demand and job openings.

This section will summarize the most recent projections of the BLS for the period 1978 to 1990 on the basis of this publication and the projections of the labor force, the economy, and employment by industry set forth in another BLS publication, Employment Projections for the 1980's (1979).

B. Population, Labor Force, National Income and Product

The population was projected by the Bureau of the Census to grow from 215 million in 1976 to between 236 and 255 million in 1990, i.e., a growth of between 9.8 and 18.6 percent, depending on the assumptions as to birth rates; nearly all the difference, therefore, is in the projection of population that will be under 16 years of age by 1990 (Census, 1977). The choice of a population projection affects demand for teachers and for certain other services and goods consumed by children. Immigration, the other variable in population growth that is difficult to predict, was assumed by the Census Bureau to average 400,000 a year. The uncertainty of such an assumption is shown by the influx of more than 100,000 Cuban refugees in a few weeks in the Spring of 1980.

The size of the labor force in 1990 will be very little affected by the alternative assumptions as to births, since these children will not reach working age; the effect will be felt in the labor force participation of women, which is affected by the presence of young children in the home. The Bureau of Labor Statistics projected the labor force to increase from 97.4 million in 1977 to between 113.5 and 125.6 million in 1990, i.e., "low," "intermediate," and "high" growth models, depending on assumptions as to the labor force participation rates. The main differences among the projections are in the assumptions about participation by black men--whether their worker rates will continue to decline, as in the past, or whether, under more favorable employment opportunities, they will rise, approaching the rates for white men. Under all assumptions, the labor force growth will be slower in the 1980's than in the 1970's.

The composition of the labor force under all these projections would be similar in that it would have a smaller proportion of young workers and more in the age group 25-54, lessening the competition for jobs among youth. The more mature labor force is likely to help the lagging rate of productivity increase of recent years. Above age 55 there will be fewer workers. One result of these changes will be a decline in the dependency ratio, nonworkers in the population as a percent of workers, which was 117.8 percent in 1977 and which would be between 85 and 120 in 1990, depending on assumptions as to the rates of population and labor force growth. This will contribute to an increase in per capita income.

In translating labor force growth into economic growth, two alternative projections were made--a base projection on the assumption of a moderately expanding labor force (reaching 119.4 million in 1990--the "intermediate growth" model), relatively slow decline in inflation and unemployment, and moderate government expenditures; and a "high employment" projection on the assumption of a larger labor force (the "high growth" model) and emphasis on job creation to lower the unemployment rate. The base projection calls for civilian employment of 114 million in 1990, compared to 90.5 million in 1977 (a 26-percent growth); the high employment projection envisages 120.6 million employed in 1990, a 33-percent growth.

Under both projections, GNP growth will slow down. Compared to the 3.7-percent growth rate of the 1955-1968 period and the 1.9-percent rate from 1973 to 1977, the base projection sees growth slowing to 3.2 percent by 1990, and the high employment projection calls for 3.5 percent. GNP would be 59 percent higher than

in 1977 by 1990 under the base assumption, 65 percent under the high employment assumption. The high employment assumption calls for a slower growth of productivity, since more inexperienced people will be in the labor force.

In both projections the share of GNP contributed by government purchases of goods and services would decline, while that of personal consumption and private investment would increase. Personal income per capita, after taxes, would be rising at double the rate for the 1973-1977 period.

C. Employment by Industry

Employment was projected to increase in 119 of the 149 industries into which the economy was divided in the study, under the base projection model. Fastest-growing major industry groups would be the services (growing at the rate of 3.3 percent annually), finance (2.4 percent), and trade (2.1 percent). Greatest numbers of additional jobs would be provided by services (9 million), trade (6.5 million) and the slower-growing manufacturing industries (4 million).

In the high-employment alternative projection, employment would be higher in almost every industry, but the principal differences would be in State and local government, hospitals, banking and drug manufacturing.

D. Employment by Occupation

In projecting occupational employment, the BLS takes off from only one of the alternative industry projections, the base assumption, and projects for 1990 only, omitting 1985. This is an unfortunate omission, since the shorter-term projection is

likely to be more accurate and would be useful for educational program planning. It would be helpful to make the projection on other economic assumptions as well, so that users of the data could see the sensitivity of the projections to a range of economic uncertainty.

The projections are summarized in Table 1. White-collar occupations will continue to grow faster than blue-collar occupations--by 23.6 percent in the 12-year period compared to 16.1 percent for blue-collar jobs--and will amount to more than half of all jobs by 1990. Fastest-growing occupations, however, will be the service group, which will grow by 35 percent. A surprising conclusion is that among white-collar occupations the professional and technical occupations, which have grown most rapidly in the past, are expected to be the slowest-growing, well behind clerical and sales workers. Laborers will be the slowest-growing group of blue-collar workers, while craftsmen, the most highly skilled, will continue to grow fastest.

There will be wide variations in growth rates for individual occupations, according to these projections. Among the fastest-growing--more than double the average of 20.8 percent for all occupations--will be many of the health service occupations; computer, business machine, and industrial machinery technicians and repairers; bank officers and bank clerks; such recreation-related occupations as travel agents, airplane pilots, flight attendants, and hotel housekeepers; cashiers, stenographers and secretaries, insurance claim representatives, purchasing agents, and such construction-related occupations as architects, boilermakers and construction machinery operators.

Table 1. Employment by Major Occupational Group, 1978 and Projected 1990
(Numbers in thousands)

Occupational Group	1978 Employment		Projected 1990 Employment		1978–90 Percent Change
	Number	Percent	Number	Percent	
Total	94,373	100.0	114,000	100.0	20.8
White-collar workers	47,205	50.0	58,400	51.2	23.6
Professional and technical workers	14,245	15.1	16,900	14.8	18.6
Managers and administrators	10,102	10.7	12,200	10.7	20.8
Sales workers	5,951	6.3	7,600	6.7	27.7
Clerical workers	16,904	17.9	21,700	19.0	28.4
Blue-collar workers	31,531	33.4	36,600	32.1	16.1
Craft and kindred workers	12,386	13.1	14,900	13.0	20.3
Operatives, except transport	10,875	11.5	12,500	11.0	15.0
Transport operatives	3,541	3.8	4,100	3.6	15.8
Nonfarm laborers	4,729	5.0	5,100	4.5	7.9
Service workers	12,839	13.6	16,700	14.6	30.1
Private household workers	1,162	1.2	900	0.9	-22.6
Other service workers	11,677	12.4	15,800	13.9	35.2
Farm workers	2,798	3.0	2,400	2.1	-14.8

Note: Detail may not add to totals because of rounding.

Source: Bureau of Labor Statistics, Occupational Projections and Training Data, 1980.

On the other hand, declines are expected in a few occupations. Among these are printing and railroad occupations such as compositors, pressmen and station agents; some telephone occupations such as operators and central office equipment installers and craftsmen; and such assorted occupations as meat-cutters, blacksmiths, postal clerks, merchant marine occupations, and motion picture projectionists. The birth rate declines of recent years will reduce jobs for teachers and college faculty.

E. Attrition and Estimated Annual Job Openings

When replacements for attrition are taken into account, the number of job openings that will be available over the 12-year period can be estimated. As noted earlier, the BLS estimates of attrition include deaths and retirements only, and are therefore minimal in many cases where there is net loss of workers to an occupation as a result of an excess of transfers to other occupations over entrances from other occupations. Net immigration, on the other hand, is appreciable in some occupations, and would reduce the available job openings.

A summary of the estimates of job openings arising from both net growth and replacement for deaths and retirements, for a large number of occupations for which vocational education provides instruction, is given in Appendix Table 1. This table is arranged by traditional vocational education instructional categories. The occupations listed are those for which labor market information is available separately; in many cases more than one occupation fits into a single vocational education category. In cases where jobs in an occupation can be filled by persons trained

in more than one vocational education instructional program (for example, electronic technicians who may be trained either in technical or in trades and industrial programs) these are cross-referenced.

For a few fields--Agriculture, Office Occupations and Distributive Occupations--the table shows not only the individual occupations for which specific curricula provide training but also the total farm workers, clerical workers and sales workers, respectively. The job openings data for these cannot, of course, be added to those for specific occupations.

In using the table one should keep several points in mind:

(1) Some occupations as defined in the manpower statistics include people trained at several levels or by several modes; for example, personnel and labor relations workers include some trained in colleges, some in other post-secondary institutions, and some through vocational programs at the secondary level. The total estimated job openings for the occupation are shown in the table, but those familiar with the field will recognize that vocational education does not have the entire training task. Recent levels of training completions by these other modes are shown in the BLS report, Occupational Projections and Training Data from which the data in the table were taken.

(2) Some occupations for which vocational education offers curricula are entered by many people without any formal pre-employment training. Examples include postal clerks, hotel housekeepers and assistants, and taxi drivers. In using the data on job openings to plan vocational education programs, one cannot assume that

if vocational education enrollments were expanded enough to fill all the estimated job openings all the graduates would be able to get jobs in the field, since they would compete with these untrained applicants. Insofar as vocational education would materially improve employability, however, the graduates would have a competitive advantage. And if it can be demonstrated that a worker receiving vocational education is more productive or earns more than one who has entered without receiving such training a case can be made for expansion of vocational education enrollments to fill all job openings estimated.

(3) Comparison of job openings with current statistics on training, which are assembled in the BLS report, has to be made with caution for these reasons, and also because openings arising from net occupational mobility and net migration are not included in the figures. A few illustrations (cosmetologists, carpenters, licensed practical nurses) will suggest some of the problems and possibilities in interpreting the data.

Cosmetologists

Employment, 1978	542,000
Projected employment, 1990	624,000
Percent growth, 1978-1990	15.1
Average annual openings, 1978-1990	28,500
Growth	6,900
Replacement for death and retirement	21,600
Available data on completions of training, 1978:	
Public vocational education	27,215
Private vocational education	51,117
Job Corps	71
Total	78,453

With 78,500 people completing training and average annual job openings of 28,500, many more people are being trained than can find jobs. This conclusion is reached

without allowing for those trained on the job, who would swell the number of entrants even further. Data on occupational mobility as reported by Eck (1980) show that net mobility accounts for about 11,500 additional job openings in a year, mostly as a result of an excess of transfers to other occupations over transfers from other occupations; withdrawals from the labor force (nearly 10 percent of those employed in the occupation) just about balanced new entrants from outside the labor force in this field in which most workers are women. Thus the tentative occupational mobility data does not alter the conclusion that many more people are being trained for this occupation than can find jobs in it. This is true even if allowance is made for some duplication in the training data resulting from the same individual taking public vocational education and subsequently completing training in the same occupation in a private school. Vocational educators have observed that many women take cosmetology training for avocational reasons; this may be true even of some of the 51,000 who paid for training in private schools. It would be useful to know how many of the graduates in cosmetology in both public and private schools looked for work in the field and how many actually got jobs; for this follow-up surveys of graduates would be needed.

In contrast to the high volume of training in cosmetology relative to job openings is the situation in the training of carpenters, our next illustration.

Carpenters

Employment, 1978	1,254,000
Projected employment, 1990	1,390,000
Percent growth, 1978-1990	10.9
Average annual openings, 1978-1990	58,000
Growth	11,000
Replacement for deaths and retirements	47,000
Available data on completions of training, 1978:	
Public vocational education	44,625
Private vocational education	374
Job Corps	1,741
Apprenticeship	3,453
Total	50,193

Current levels of training, at 50,000 annually, appear to be close to providing enough newly trained workers to fill the 58,000 job openings expected annually. This is an occupation that workers enter and leave in large numbers, so that the difference could easily be made up by an influx of persons other than new trainees. (In Eck's data, 11.2 percent of the carpenters switched to other occupations, but 10 percent switched from other occupations into this one, indicating the extent of availability of workers with carpenters' skills in other occupations.) There would be no basis for a decision to raise enrollments in vocational education programs for carpenters.

Our third example, the occupation of licensed practical nurse, is one in which the available data indicate that enrollments may need to be expanded.

Licensed practical nurses

Employment, 1978	518,000
Projected employment, 1990	840,000
Percent change, 1978-1990	62.2
Average annual openings, 1978-1990	60,000
Growth	26,000
Replacement for deaths and retirements	34,000
Available data on completions of training, 1978:	
Public vocational education	34,399
Private vocational education	3,242
Junior college courses	3,019
Job Corps	42
Total	40,702

Training for licensed practical nurses is given in State-approved courses, generally for one year. In addition to institutions listed above, the courses are given in hospitals and health agencies, but we have no data on the numbers completing such training. If on investigation hospitals' and health agencies' training fall short of filling the gap between 40,000 trainees and 60,000 openings, there is room for expansion of vocational education or other existing training programs. The Eck data on occupational mobility show only 1.5 percent of practical nurses entering from other occupations annually, and none transferring to other occupations, but substantial withdrawals from the labor force and reentrance into the labor force by practical nurses, amounting to 10 to 11 percent of the work force annually, as would be expected in an occupation predominantly female.

These three examples show the need for interpreting both the estimates of job openings and the data on current training activity cautiously, and the need to go beyond these data in some cases before drawing conclusions for planning vocational education programs.

F. Actual Employment Experience of Vocational Education Graduates

With all the uncertainties involved in projecting future employment trends and occupational attrition, and in drawing inferences for vocational education planning by comparing these estimates with even more uncertain labor supply estimates, many vocational education officials would rather rely upon actual experience. Have the graduates of the various programs gotten jobs in the fields for which they were trained? How do their employment experience and earnings compare with those of persons who did not take vocational education? How do employers evaluate their training? This information reflects the past rather than the future, but by that very token is fact rather than speculation. Information on the employment and earnings experience of graduates could also be used to compare the efficacy of different methods of teaching the same skills, and therefore help to improve instructional methods.

Follow-up of graduates has long been recognized in the vocational education community as a way of evaluating their results. Summary data on the proportion of graduates available for work who found employment in their fields or in related fields, and those unemployed, have been collected and published for years. Some State officials sent out a mailed questionnaire; in other States the teachers were depended on to keep in touch with graduates. There was wide latitude in the interpretation of "related fields"--a concept which would have to differ from one instructional program to another. In mailed questionnaires it was left to the responding graduate to interpret.

The newly introduced Vocational Education Data System (VEDS) requires follow-up on at least a 20-percent sample of graduates, and some States do it on all graduates; moreover, data will be collected in uniform ways and compiled by uniform standards. Instead of asking the graduate or his teacher whether he found a job in a field related to his training, the actual job will be reported and classified according to the Standard Occupational Classification system. Also, the VEDS system includes a questionnaire to the employer to get his view on how well the graduate was prepared by his training; this is to provide information to meet the evaluation criteria specified in the 1976 legislation, which include whether the graduate's training was satisfactory in the eye of the employer.

Interpretation of the results of follow-up surveys is not simple. A poor placement record could reflect a deficient instructional program, a temporarily depressed employment situation (the projections of demand focus on long-term trends and ignore cyclical swings), failure to plan training in the light of anticipated employment opportunities, or even discrimination in employment.

Moreover, a second look should be given to the use of the percentage of graduates who get a job related to their training as a criterion of program success. This approach is a straightforward method in program evaluation, and is plausible at first glance. But it requires the assumption that the vocational choice leading to taking the particular course of study represents a considered and permanent commitment. In fact it is common experience that many people, especially youth, change their minds, develop new interests, or respond to attractive opportunities

that arise in other fields; in such cases their getting a job unrelated to their training does not represent a failure of the training.

All these considerations lead to the conclusion that the results of follow-up surveys should be used, not as the definitive evaluation criterion, but as a lead to further evaluation studies. Where the placement record for a particular vocational education program in a community is found to be poor, an intensive study should be undertaken, involving evaluation of the labor market, determining the attitudes of employers towards the training (not only employers who hire graduates but also those who do not) and interviews with graduates who do not find employment related to their training. State or local agencies should have the capability to make these evaluation studies, under the aegis of advisory committees on vocational education or State Occupational Information Coordinating Committees.

A recurrent problem in follow-up surveys is the failure of some graduates to respond, or of teachers to be able to report on all of their graduates. Since non-response is likely to be associated with failure to get a job in the field, missing any significant number of graduates may invalidate the survey's conclusions. To control for this, it is necessary to build into the survey a procedure for tracking down a subsample of the nonrespondents and getting some idea of how their experience compares with that of respondents.

A well-designed and uniformly conducted system of follow-up surveys and evaluation studies is essential to assuring that the mission of vocational education is successfully carried out.

IV. USE OF MANPOWER PROJECTIONS FOR PLANNING VOCATIONAL EDUCATION

A. The Roles of National and Local Projections in Vocational Education Planning

The national projections just reviewed are not as pertinent to planning vocational education as are the associated projections of the State agencies, since the planning is done at State and local levels. The national projections do serve the purpose, however, of taking a summary look at the way in which training is related to manpower needs--i.e., how the efforts of public vocational education in all the States, and of other modes of occupational preparation, add up in relation to the total needs. Geographical mobility limits the interpretation of the outcome of efforts in individual States, since those trained in one may fill jobs in another. The national projection, taken together with national summaries of training given by all modes, makes it possible to calculate the total impact of public vocational education as well as other modes of training.

This section of the report will discuss the use of manpower data in planning and evaluating vocational education. We will first review some of the problems in the vocational education data and then those in relating the two systems of data. A final section will touch on some of the organizational and institutional aspects of the vocational education system that militate against an effective and flexible response to the changing employment situation.

B. Problems in Statistics of Vocational Education

There are a few problems with the data on enrollments and completions that affect their use in conjunction with the manpower data.

(1) The common coin of the vocational education data system is "programs" in the various curricula. Programs differ in content from State to State or among localities within a State. In some cases a program consists of only a few courses, in others, many more, but all are listed as "programs" presumably qualifying graduates for entry into an occupation. This is to be expected, given decentralization of education. It does not interfere with local juxtaposition of supply with demand data, the most essential planning use, but does weaken national comparisons of completions with openings.

(2) The statistics compiled for the Federal government by the States exclude some of the completions of programs not supported by Federal grants. The VEDS coverage is limited to "programs covered by the State plan," which is interpreted in some States to exclude some rather large State- or locally-supported programs.

(3) There is some duplication of reporting between VEDS and CETA of CETA-sponsored students in public vocational schools (e.g., in Florida), and between VEDS and the national system of statistics on apprenticeship when apprentices are enrolled in public vocational courses for their related trade training. This may not be significant quantitatively, but may become more significant when national summaries of CETA completions once more become available.

(4) States vary in the detail on curriculum or program categories in which they keep their data on program completions and follow-up. VEDS has reduced the amount

of detail required from 160 to 110 categories; there is the danger that States will follow suit and collapse the categories in their own records in such a way as to make comparison with manpower data difficult.

C. Problems in Interpreting the Juxtaposed Manpower and Education Data

Severe problems arise when one tries to compare data from the two systems. This is not solely a difference arising out of the practices of statisticians in the two institutional settings--it is in part a difference between the two subcultures.

(1) Specification of the mode of training needed for entrance into various occupations is difficult in many cases. Where entrance to an occupation is controlled by licensure or certification which requires specified training, this is relatively clear-cut, although it may differ from State to State. Most occupations, however, are not licensed. Qualifications may be set by custom or labor-management agreements, but employers' hiring standards are typically self-determined and responsive to the market. Employers usually have the flexibility to raise or lower standards, or to hire partially qualified workers if they cannot find fully-qualified ones. Some employers prefer one mode of training over others, depending on their own experience or perceptions, the quality of the various training institutions in their community, or differences among firms in the way the work is performed, the amount of supervision provided, etc. The Bureau of Labor Statistics interviews a few firms, unions, trade associations or professional societies in each of the hundreds of occupations on which it publishes outlook information, but does not have the resources to make a careful survey of hiring standards that would enable it to say what proportion of the job openings require this or

that mode and amount of training; moreover, such information would be ephemeral and transitory, changing with the market as well as with the quality and availability of training programs. State employment security agencies supplement the national Occupational Outlook Handbook with local publications on employment opportunities, and they get some idea of employers' standards through their placement services, so their information on hiring standards with regard to training can be more helpful to local vocational education authorities. Finally, the latter have a responsibility to ascertain the preferences of employers in their communities and adapt the curricula to the market.

(2) It is not always possible to match curricula and occupations, since some skills are required in a variety of occupations. Courses are offered in skills like welding or blueprint reading that are part of the bag of skills needed in many occupations. Electronics is a body of knowledge, imparted through vocational courses and applicable in many technician and repair occupations. Office practice is another broad subject matter applicable to a variety of occupations.

To meet this problem a number of efforts have been made to develop bridges or "crosswalks" from one classification system to another. The issue is complicated by the lack of uniformity of occupational classification: until recently there were two general systems in use, the census classifications, listing about 400 titles into which all job titles found in the United States were grouped, and the Dictionary of Occupational Titles (DOT) used in the public employment services, which listed as many as 12,000 detailed occupations. More recently a Standard Occupational Classification

(SOC) system for use in compiling statistics was developed by an interagency effort under the leadership of the Office of Federal Statistical Policy and Standards, which was then in the Office of Management and Budget. Over the years various crosswalks were developed, one (Vocational Education and Occupations, 1969) between an earlier edition of the DOT and a contemporary Office of Education classification system for instructional categories (Handbook No. 6), a second (Matching Occupational Classifications to Vocational Education Program Codes, 1975) between Handbook No. 6 and census categories, a third (Vocational Preparation and Occupations, 1979) between Handbook No. 6 and the current edition of the DOT as well as the census, the SOC, and the categories used by the BLS in its collection of employment statistics by occupation (which departed from both the census and DOT systems). The National Center for Educational Statistics has recently completed a draft of a new vocational education curriculum classification system which is intended to be introduced with VEDS, and the National Occupational Information Coordinating Committee is planning to develop a new crosswalk to tie it to the occupational classification systems in which manpower data are grouped. These bridging efforts go far to enable educators to understand and use manpower data, but problems arising out of the differences between bodies of knowledge and groups of skills needed for occupations will continue to hamper communication between the subcultures.

(3) Difficulties in getting complete supply information have been encountered by State and local officials. The problem is to bring together on a current basis the enrollments and particularly completions of the several modes of training for each

occupation in the State and the communities. Some State Occupational Information Coordinating Committees are making surveys of training institutions to build up estimates of the total supply of graduates. In some cases proprietary schools consider their enrollments to be confidential information they are reluctant to share with competitors or the public. As a result of difficulties such as these some State employment security agencies publish estimates of manpower demand without any supply information while others can publish data on graduates as well.

But the problem goes beyond getting the most recent data on completions or enrollments. How can each institution take into account the intentions of the others to expand or contract enrollments? All of them want a piece of the action. The coordinating committees are empowered to coordinate information, but not the training programs themselves. Discussion and exchange of information may help achieve some coordination of training activity at a State or local level, but this cannot be counted on. At the national level there are no mechanisms for discussion (other than NOICC) and no agencies or professional groups have been empowered to negotiate on behalf of their members.

(4) There are two problems related to the identification of the geographical area for vocational education planning. The first of these is the disparity between the boundaries of the administrative units for vocational education (school districts, cities, counties) and those of the labor market areas or metropolitan areas--the way in which manpower data are organized. Educational officials in many cases request data on manpower needs or employment opportunities

in the more narrowly defined areas with which they work--data impossible for the manpower officials to deliver. NOICC has recommended uniform use of labor market areas, as defined by the Department of Labor.

A more general problem is that a very large proportion of the youth who take vocational education may get their first job in their home community, but ultimately move elsewhere to work. The 1960 census showed that about four out of ten adult men were working and living in a different county than the one in which they lived at the age when they were in high school; half of these were in a different State. If the schools plan their curricula solely on the basis of the occupational opportunities in a school district or other narrowly defined areas--and local industry, which pays a good share of the taxes, is interested in this--they may do a disservice to the many who will work elsewhere. This is tempered by the fact that some of the movers are those who go to college, rather than those who depend on vocational education for their principal vocational preparation. College graduates are the most mobile part of the population, but they are a good deal less than 40 percent of the population, so many of the movers must be non-graduates. Having pointed out the issue, one must confess that a formula for combining the occupational needs of even a large area and those of a broader region or the United States as a whole does not come readily to mind. In any event, planning cannot be rigidly geared to the narrow confines of school districts, counties, or even States.

D. Organizational and Institutional Impediments to Planning Vocational Education in the Light of Employment Opportunities

(1) The decentralization of control in education, a long-standing principle in Federal-State relations in education, is at the heart of many of the difficulties in assuring the adaptation of the training programs to the labor market demands. The Office of Education has tried the device of the State Plans for Vocational Education, which must be approved before annual funding is authorized, as a way to attain some adherence to standards, including the one relating to employment opportunities. This has not been effective as a means of getting States to pay attention to the problem, for a variety of reasons: in the early years after the 1963 and 1968 legislation, lack of information on manpower needs, because the Office could get no funds from Congress to transfer to the Labor Department; later because the States, even without funds from HEW, were only slowly developing their programs to provide the information; at all times because State vocational education agencies were dependent on local education officials to generate the plans; and finally, because the Office of Education was not in a strong position to insist on gearing the plans to manpower information. The State plans, with or without some purported showing of data on manpower needs, were coming in and had to be approved so that funds could be sent, and of all the sins of omission or commission the plans embodied, inadequacy in this particular section of the plan was not an important enough issue to the Office to make it take a tough stand against the pressures the States and their Congressional delegations could generate. It became evident to the States that all they had to do was put

in some manpower data and pay some pro forma attention to the subject in the State plan and they could get by.

Within the States relations between State and local educational officials differ; in some (e.g., Colorado and Oregon) State agencies have the ability to affect the local decisions on setting up new programs; in Minnesota placement of graduates shown by follow-up surveys determines whether courses are dropped; in most other States there is no central control. There are no arrangements for sub-State or regional planning in most of the States, so they do not coordinate with each other. This is illustrated by the experience of one local school, which got the idea of offering training in the growing occupation of bank teller--an attractive program to offer because it requires little equipment, and so lowers the average cost of a vocational education program. This was successful; the graduates got jobs. Soon the surrounding school districts caught on to the idea and offered bank teller programs of their own, and in no time the market was saturated with graduates in search of banks. This kind of healthy competition is the life of a free-enterprise system where profits or the lack thereof control overproduction; but in government, lacking such control, both graduates and taxpayers lose. The only control available is planning training on the basis of estimated job openings, together with experience in placement.

(2) The State and local administrators of vocational education have difficulty in using manpower data, in part because they are unfamiliar with it. They are most often people who started as vocational teachers and moved up in the

system. Few have had training in statistics, economics or labor market analysis, and many lack experience in the business or industrial world. Graduate programs in vocational education administration in universities, and in-service training for vocational education officials should be reviewed to see whether more systematic study of industrial economies or the labor market could be added to help administrators to handle this responsibility. Their more active participation in SOICC's, when the manpower data to be used in their planning are specified, might aid in their understanding of the data.

(3) Vocational education administrators have very limited ability to adjust their programs flexibly to the needs as indicated by information on employment opportunities. Curtailing or eliminating programs is not easy when tenured teachers with single specialties are employed in the system. Expensive equipment, difficult to buy in the first place and to abandon once bought, imposes similar rigidities. In smaller communities schools cannot provide training for occupations in which there are only a few local job openings annually because classes would be too small to warrant assigning a teacher or a classroom. These realities help to explain why the same courses are offered year in and year out.

V. CONCLUSIONS AND RECOMMENDATIONS

This review has shown that, with all the uncertainties, inaccuracies and shortcomings inherent in projections, they are not the principal source of difficulties in planning vocational education in the light of employment opportunities.

There is a reasonable expectation that the quality of the projections can be improved if data collection (like the occupational employment statistics survey and occupational mobility surveys) can continue and as research into method yields results. A national Federal-State cooperative mechanism for making projections is now in place and functioning, so that improvements in methods can find their way into practice.

Difficulties lie in the next step of drawing the implications of the projections for programming vocational education. They arise from the institutional structure of vocational education, and from the difficulties of bridging the two worlds of education and economics. Some of these can be overcome with work to improve the statistics of vocational education and identify the relationships of curricula to occupations. Others are more intractable, arising out of the traditional Federal-State relationships in education and the rigidities--many of them inevitable--in managing school systems in tens of thousands of local jurisdictions.

The National Occupational Information Coordinating Committee and its State counterparts have an essential role in giving leadership and stimulation to program improvements both on the demand side and on the supply side, and in coordinating development of data on both the labor market and the educational system that can be compared and analyzed.

A number of recommendations for improvement of the information system were implied by this review.

The Department of Labor should assure that the Occupational Employment

Statistics collection can be extended to all the States, and its continuing funding should be assured. Funding difficulties have resulted in part from the fact that the data serve not only the Department's own manpower training programs but also the vocational education community; at a time of budget stringency there is a natural tendency to see if you can't tap the other fellow for some of the cost. Thus, the very fact that the program is so widely useful is interfering with its being able to get sound financial support. The Congress, whose mandates to base training on realistic information the program is designed to fulfill, has a special responsibility here. Compared to the billions of dollars spent on education and training, the costs of getting adequate information to administer the programs are not excessive.

Now that the basic design of the survey has been developed, and several cycles of data collection completed, it is essential to get the research on occupational composition under way. As a first step, minimum information on the types of production process used, or other variables that explain differences in occupational composition within industries, should be added to the survey questionnaires.

Five-year projections of demand by occupation should be made in addition to the more ambitious, and probably less reliable, projections for ten or more years.

Research on occupational and geographical mobility should be pushed vigorously, so that a better understanding of the labor supply in each occupation is

attained, and so that net out-mobility and net-outmigration can be adequately accounted for in estimating job openings for newly-trained workers. In addition to further research by the Bureau of Labor Statistics, the Employment and Training Administration, which funds manpower research outside the government, should also help by emphasizing this area of study.

Improvements in methods of projecting State and local employment should also be sought by research, along lines indicated by a study cited in this paper, funded by the Employment and Training Administration (Harvey Goldstein, 1980).

The Department of Education should strengthen its newly developing Vocational Education Data System (VEDS) to attain more complete and uniform statistics on completions and enrollments by type of training. Information on training not coming under State plans should be collected, since it is essential in evaluating the labor supply component of future employment opportunities. Duplication of reporting of CETA-sponsored trainees should be flagged in the statistics so that an unduplicated count of completions in each occupational field can be made. More occupational detail should be tabulated so that supply/demand analysis can be made for all occupations significant in vocational education.

State agencies and State Occupational Information Coordinating Committees should assure that all institutions providing occupational training submit information on their completions, if not their enrollments, by field, so that the total contribution of training to the supply of new workers can be estimated.

All States should assure that currently revised and up-to-date vocational

guidance information on all important local occupations will be provided to students and other prospective trainees in all vocationally-oriented education and training programs. The information should more clearly indicate the future employment opportunities in each occupation. To the extent possible, the quantitative estimates of job openings and supply provided to education and training authorities should be given to individuals as well, to strengthen the generalized statements on employment opportunities now included in vocational guidance publications.

The results of surveys of the subsequent employment experience of graduates should be followed up by intensive studies in States and local areas to determine the reasons why graduates do not get jobs in their fields.

Failure to use manpower projections by vocational education officials has been attributed to their lack of understanding or even suspicion of the estimates, as well as failure of the estimates to focus on the needs for information as seen by people in the field of vocational education. Greater participation of State and national officials in the design and planning of work in the projections should contribute both to their usefulness, and to their actual utilization.

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Appendix Table 1. Annual Average Job Openings, 1978-1990, in Major Occupations for Which There Are Vocational Education Instructional Programs

	Vocational education code[1]	Annual average job openings, 1978-1990		
		Total	Employment change	Replacement needs[2]
Agricultural Occupations				
Farmers, farm managers and farm laborers		109,000	- 33,000	142,000
Farm equipment mechanics	01.0301	3,500	1,300	2,200
Forestry technicians	01.0601	700	300	400
Range managers	01.0608	200	100	100
Foresters	01.0700	1,400	500	900
Distribution Occupations				
Sales workers, total		400,000	142,000	258,000
Public relations workers	04.0100	7,500	2,600	4,900
Display workers	04.0100	3,250	1,300	1,950
Automobile sales workers	04.0300	10,400	3,500	6,900
Automobile service advisors	04.0300	1,100	500	600
Bank officers and managers	04.0400	28,000	15,000	13,000
Security sales workers	04.0400	5,500	900	4,600
Floral designers	04.0500	4,200	1,700	2,500
Retail trade sales workers	04.0800	226,000	78,000	148,000
Wholesale trade sales workers	04.0800	40,000	10,000	30,000
Buyers	04.0800	7,400	2,200	5,200
Purchasing agents	04.0800	13,400	6,800	6,600
Collection workers	04.0800	4,600	1,400	3,200
Hotel managers and assistants	04.1100	8,900	2,100	6,800
Hotel front office clerks	04.1100	5,400	1,700	3,700
Bellhops and bell captains	04.1100	600	- 100	700
Manufacturers' sales workers	04.1200	21,700	8,000	13,700
Insurance claim representatives	04.1300	10,250	5,600	4,650
Insurance agents, brokers and underwriters	04.1300	30,000	9,500	20,500
Gasoline service station attendants	04.1600	5,200	- 1,600	6,800
Real estate agents and brokers	04.1700	50,000	10,000	40,000
Airline reservation and passenger agents	04.1900	2,200	700	1,500
Airline flight attendants	04.1900	4,800	2,300	2,500
Railroad station agents	04.1900	- 200	- 300	100
Intercity bus drivers	04.1900	500	25	475
Local transit bus drivers	04.1900	3,100	1,200	1,900
Taxicab drivers	04.1900	4,300	0	4,300

	Vocational education code[1]	Annual average job openings, 1978-1990		
		Total	Employment change	Replacement needs[2]
Health occupations				
Dental assistants	07.0101	11,000	6,300	4,700
Dental hygienists	07.0102	6,000	2,500	3,500
Dental laboratory technicians	07.0103	2,800	1,900	900
Medical laboratory workers	07.0200	14,800	4,600	10,200
Registered nurses	07.0301	85,000	43,000	42,000
Licensed practical nurses	07.0302	60,000	26,000	34,000
Nursing aides, orderlies and attendants	07.0303	94,000	45,000	49,000
Operating room technicians	07.0305	2,600	1,400	1,200
Occupational therapy assistants	07.0401	1,100	400	700
Physical therapy assistants	07.0402	400	200	200
Medical record technicians and clerks	07.0499	4,900	1,300	3,600
Radiologic (x-ray) technologists	07.0501	9,000	3,300	5,700
Dispensing opticians	07.0601	1,200	600	600
Ophthalmic laboratory technicians	07.0601	1,400	500	900
Optometric assistants	07.0603	1,200	500	700
Electroencephalographic technologists and technicians	07.0901	500	300	200
Respiratory therapy workers	07.0903	5,000	2,300	2,700
Funderal directors and embalmers	07.0909	2,200	0	2,200
Occupational Home Economics				
Hotel housekeepers and assistants	09.0205	2,000	800	1,200
Office Occupations				
Clerical workers, total		1,383,000	400,000	983,000
Bookkeeping workers	14.0102	96,000	18,000	78,000
Bank clerks	14.0102	45,000	21,000	24,000
Railroad station agents	14.0103 (see 04.1900)			
Cashiers	14.0103	119,000	58,500	60,500
Office machine operators	14.0104	9,700	3,500	6,200
Bank tellers	14.0105	17,000	4,000	13,000
Computer operating personnel	14.0201	12,500	- 100	12,600
Programmers	14.0203	9,200	6,100	3,100
Systems analysts	14.0204	7,900	5,700	2,200
File clerks	14.0302	16,500	5,100	11,400
Statistical clerks	14.0303	23,500	8,200	15,300
Telegraphers, telephoners and tower operators (railroad)	14.0401	50	- 250	300

	Vocational education code[1]	Annual average job openings, 1978-1990		
		Total	Employment change	Replacement needs[2]
Office occupations (cont.)				
Postal clerks	14.0403	2,000	- 4,000	6,000
Mail carriers	14.0403	7,000	1,000	6,000
Receptionists	14.0406	41,000	14,000	27,000
Library technicians and assistants	14.0499	7,700	1,000	6,700
Medical record technicians and clerks	14.0499	4,900	1,300	3,600
Shipping and receiving clerks	14.0503	22,000	8,800	13,200
Stock clerks	14.0504	23,000	7,800	15,200
Personnel and labor relations workers	14.0602	17,000	6,000	11,000
Secretaries and stenographers	14.0602	305,000	138,000	167,000
Credit managers	14.0899	2,200	600	1,600
Typists	14.0900	59,000	17,000	42,000
Collection workers	14.9900	(see 04.0800)		
Technical Occupations				
Engineering and science technicians	16.0100	23,400	12,700	10,700
Electrical technicians	16.0107	(see 17.1400 etc)		
Electronic technicians	16.0108	(see 17.1503)		
Computer service technicians	16.0108	5,400	4,800	600
Registered nurses	16.0305	(see 07.0301)		
Airplane pilots	16.0601	3,800	2,800	1,000
Fire and fire safety technicians	16.0602	(see 17.2801)		
Forestry technicians	16.0603	(see 01.0601)		
Police science	16.0605	(see 17.2302)		
Trades and Industrial Occupations				
Air conditioning, refrigeration and heating mechanics	17.0100	8,200	2,900	5,300
Appliance repairers	17.0200	6,900	2,900	4,000
Automobile body repairers	17.0301	7,800	4,300	3,500
Automobile painters	17.0301	2,000	1,000	1,000
Automobile mechanics	17.0302	37,000	16,000	21,000
Truck and bus mechanics	17.0302	6,800	3,300	3,500
Airplane mechanics	17.0401	3,500	1,100	2,400
Air traffic controllers	17.0403	700	400	300
Business machine repairers	17.0600	4,200	2,950	1,250
Interior designers	17.0701	3,600	1,400	2,200
Display workers	17.0702	(see 04.0100)		
Industrial designers	17.0703	550	200	350
Merchant marine sailors	17.0801	- 250	- 700	450
Merchant marine officers	17.0802	700	- 50	750

	Vocational education code[1]	Annual average job openings, 1978–1990		
		Total	Employment change	Replacement needs[2]
Trades and Industrial Occupations (cont.)				
Photographic laboratory occupations	17.0900	2,700	900	1,800
Carpenters	17.1001	58,000	11,000	47,000
Electricians, construction	17.1002	12,900	5,000	7,900
Electric sign repairers	17.1002	700	300	400
Bricklayers, stonemasons and marblesetters	17.1004	6,200	1,300	4,900
Tilesetters	17.1004	1,800	1,000	800
Painters	17.1005	26,000	6,000	20,000
Paperhangers	17.1005	1,500	200	1,300
Plasterers	17.1006	1,100	200	900
Plumbers and pipefitters	17.1007	20,000	7,000	13,000
Roofers	17.1010	4,500	2,200	2,300
Insulation workers	17.1099	2,600	1,600	1,000
Ironworkers	17.1099	4,100	2,200	1,900
Cement masons and terrazo workers	17.1099	4,400	2,300	2,100
Construction laborers	17.1099	49,000	10,000	39,000
Floor covering installers	17.1099	3,200	1,800	1,400
Glaziers (construction)	17.1099	1,000	500	500
Millwrights	17.1099	4,700	1,900	2,800
Boilermaking occupations	17.1099	3,100	1,600	1,500
Building custodians	17.1100	176,000	38,000	138,000
Drafters	17.1300	11,000	5,900	5,100
Maintenance electricians	17.1400	15,500	7,000	8,500
Line installers and cable splicers	17.1402	600	100	500
Signal department workers (railroad)	17.1402	450	100	350
Telephone and PBX installers and repairers	17.1501	3,000	1,700	1,300
Central office craft occupations (telephone)	17.1501	1,000	- 400	1,400
Central office equipment installers (telephone)	17.1501	- 100	- 300	200
Television and radio service technicians	17.1503	6,100	2,900	3,200
Blue-collar worker supervisors	17.1700	69,000	21,000	48,000
Compositors	17.1901	3,900	- 1,900	5,800
Lithographers	17.1902	2,300	1,400	900
Printing press operators and assistants	17.0902	5,000	1,200	3,800
Photoengravers	17.1904	150	- 50	200
Bookbinders and bindery workers	17.1906	2,600	100	2,500
Ophthalmic laboratory technicians	17.2101	(see 07.0601)		
Dispensing opticians	17.2101	(see 07.0601)		

	Vocational education code[1]	Annual average job openings, 1978-1990		
		Total	Employment change	Replacement needs[2]
Trades and Industrial Occupations (cont.)				
Boat and engine mechanics	17.2200	1,000	400	600
Molders	17.2301	500	100	400
Coremakers	17.2301	350	50	300
All-round machinists	17.2302	21,000	7,000	14,000
Instrument makers (mechanical)	17.2302	300	100	200
Machine tool operators	17.2302	19,600	5,600	14,000
Set-up workers (machine tools)	17.2302	3,000	1,400	1,600
Sheet metal workers	17.2305	3,500	1,700	1,800
Welders	17.2306	35,000	19,000	16,000
Tool-and-die makers	17.2307	10,400	4,800	5,600
Electroplaters	17.2399	800	0	800
Forge shop occupations	17.2399	2,000	200	1,800
Blacksmiths	17.2399	300	- 300	600
Inspectors (manufacturing)	17.2400	35,000	11,500	23,500
Barbers	17.2601	9,700	1,600	8,100
Cosmetologists	17.2602	28,500	6,900	21,600
Firefighters	17.2801	7,500	3,900	3,600
Police/officers	17.2802	16,500	8,500	8,000
State police officers	17.2802	1,800	1,000	800
Guards	17.2802	70,000	20,000	50,000
Construction inspectors (government)	17.2899	2,200	800	1,400
Health and regulatory inspectors (government)	17.2899	5,800	2,000	3,800
Cooks and chefs	17.2902	86,000	31,000	55,000
Meatcutters	17.2903	5,200	- 1,400	6,600
Waiters and waitresses	17.2904	70,000	21,000	49,000
Food counter workers	17.2904	34,000	15,000	19,000
Boiler tenders	17.3200	2,800	0	2,800
Stationary engineers	17.3200	7,700	600	7,100
Shoe repairers	17.3402	1,600	- 100	1,700
Upholsterers	17.3500	1,100	0	1,100

[1] Vocational education codes are from U.S. Department of Health, Education, and Welfare and U.S. Department of Labor, Vocational Education and Occupations (1969).

[2] Replacement needs include openings arising from deaths, retirements, and other separations from the labor force. Does not include transfers to other occupations.